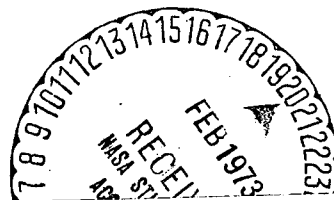# CIRCADIAN PHASE RELATIONSHIPS IN MONKEYS

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Two adult male pigtail monkeys were placed in an isolated, soundproofed chamber (entered for cleaning only) for a period of six months, during which time their deep body temperatures (T_{DB}, telemetered from transmitters implanted in the abdominal cavity), fluid intake, urinary output (UV), urinary sodium and potassium were continuously monitored. During the first 3 1/2 months, lights (L) were turned on at 0000 hours, off at 1200 hours. Photoperiod phase was then delayed (light span prolonged) 6 hours to a new schedule: L on at 0600 hours, off at 1800 hours. Six weeks later, photoperiod phase was advanced 6 hours to return to the original schedule. Prior to shift, T_{DB} typically began a steep rise 0-5 hours prior to L on, a steep fall 3-4 hours prior to L off, relative plateaus in between. Urinary Na typically peaks 2 hours prior to L off, has a minimum 2-4 hours prior to L on; K tends both to peak and show a minimum 2-8 hours earlier than Na; in contrast, UV peaks at L on, has a minimum 2-6 hours after L off. Upon delaying photoperiod phase, T_{DB} shift was completed in 8 days. UV shifted more rapidly but tended to overshoot the new phase. Within 5 days, UV and K completed their shifts, although Na did not fully resynchronize within the 6 week period monitored. (Supported by NASA NGR 05-004-038 and NGR 05-004-053.)
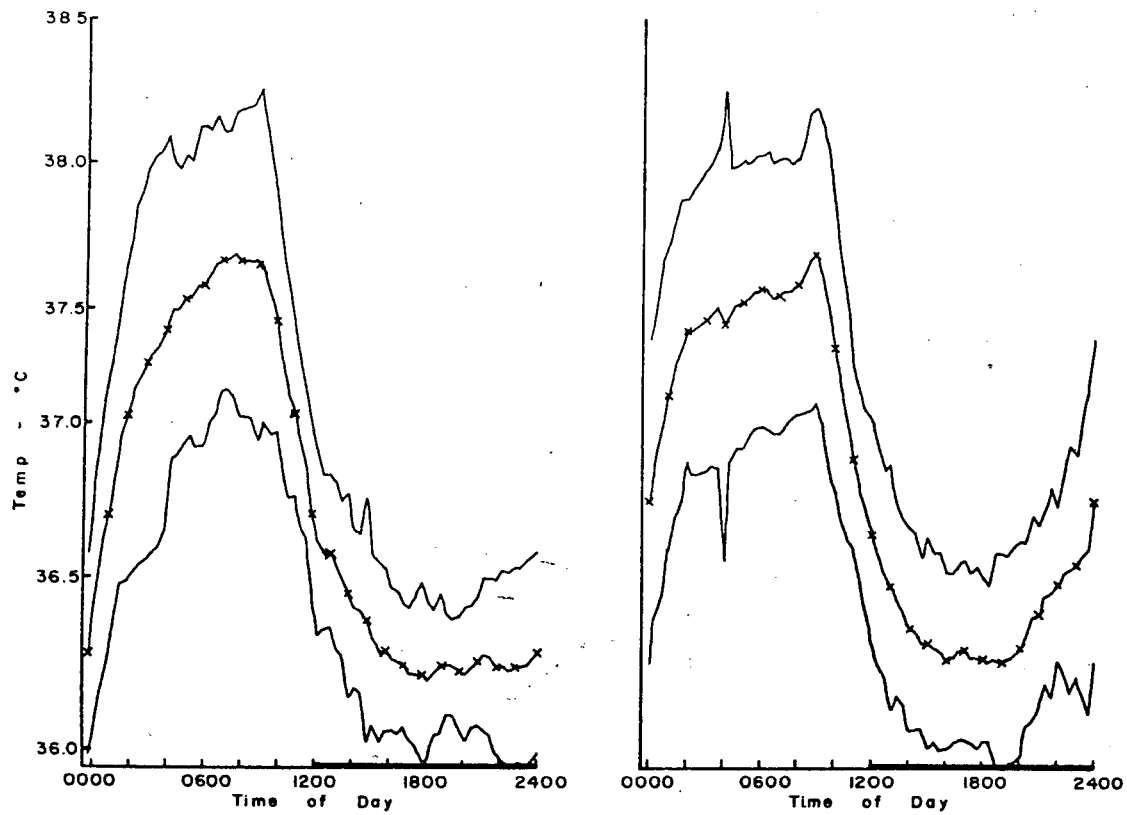
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Figure 1.   Maximum, minimum and mean deep body temperatures during three
and one half months prior to phase shift. Two male pigtail
monkeys, temperatures telemetered from abdominal cavity. Lights
on at 0000 hours, off at 1200 hours.
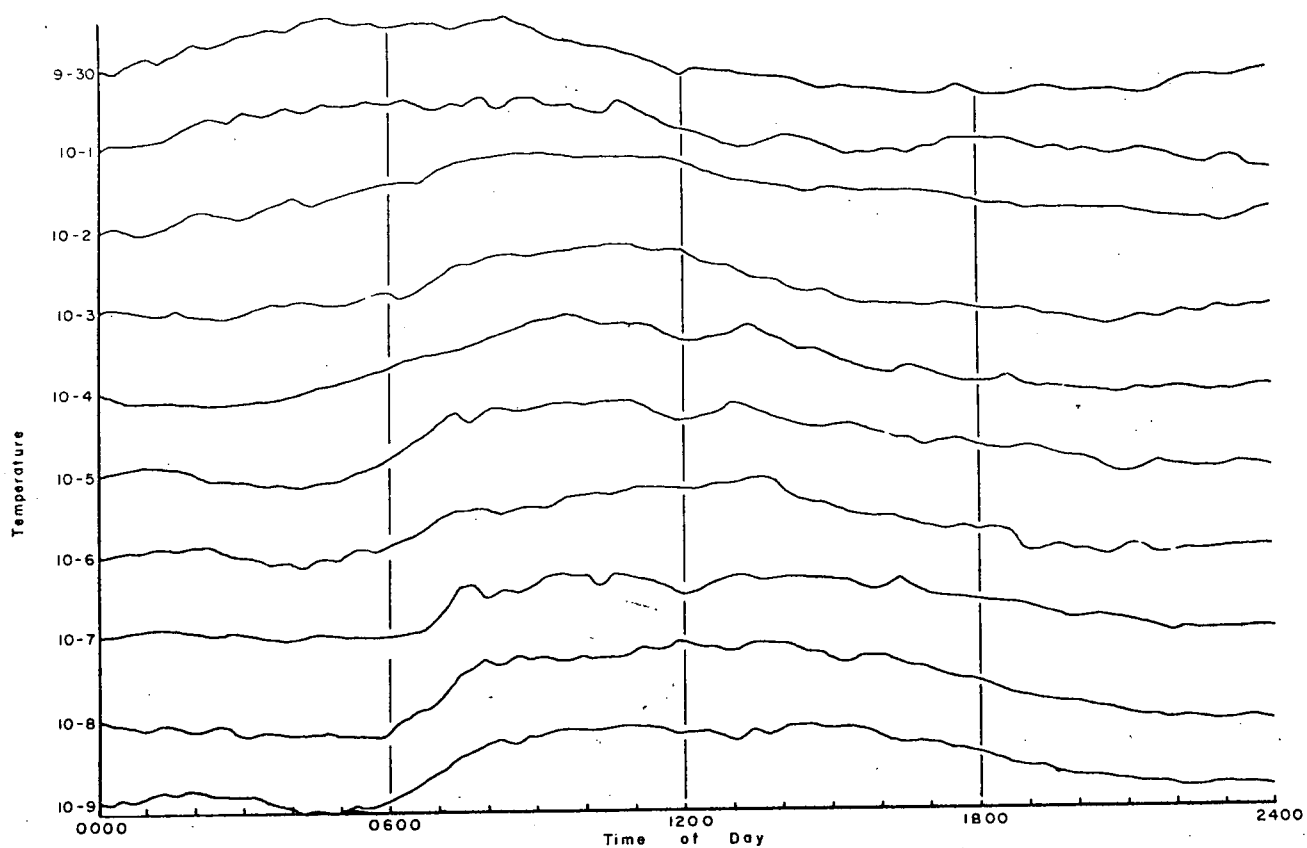
Figure 2.   Deep body temperature of male pigtail monkey following six hour
             photoperiod phase delay on 9-30. New light schedule: lights on
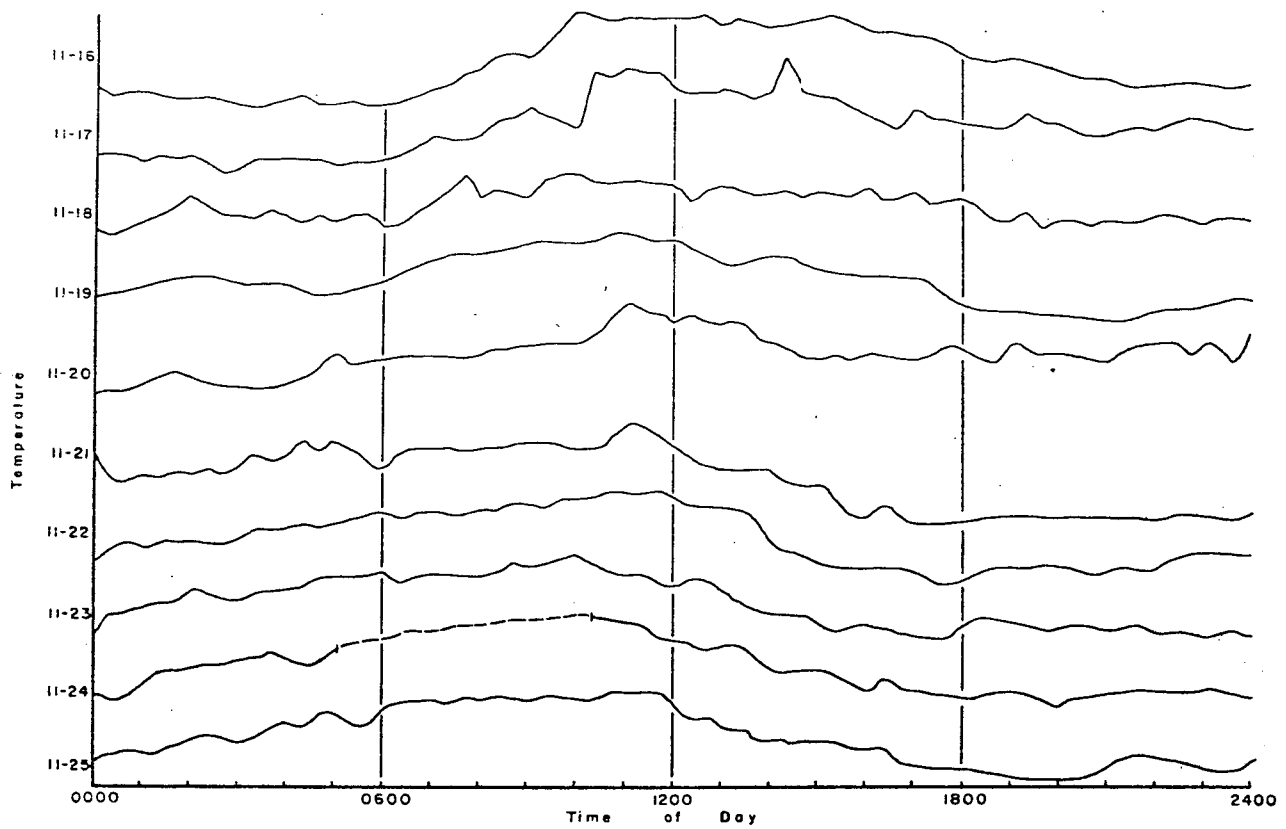   at 0600 hours, off at 1800 hours.

Figure 3.   Deep body temperature of subject of Figure 2 following six hour
photoperiod phase advance on 11-16. New light schedule: lights
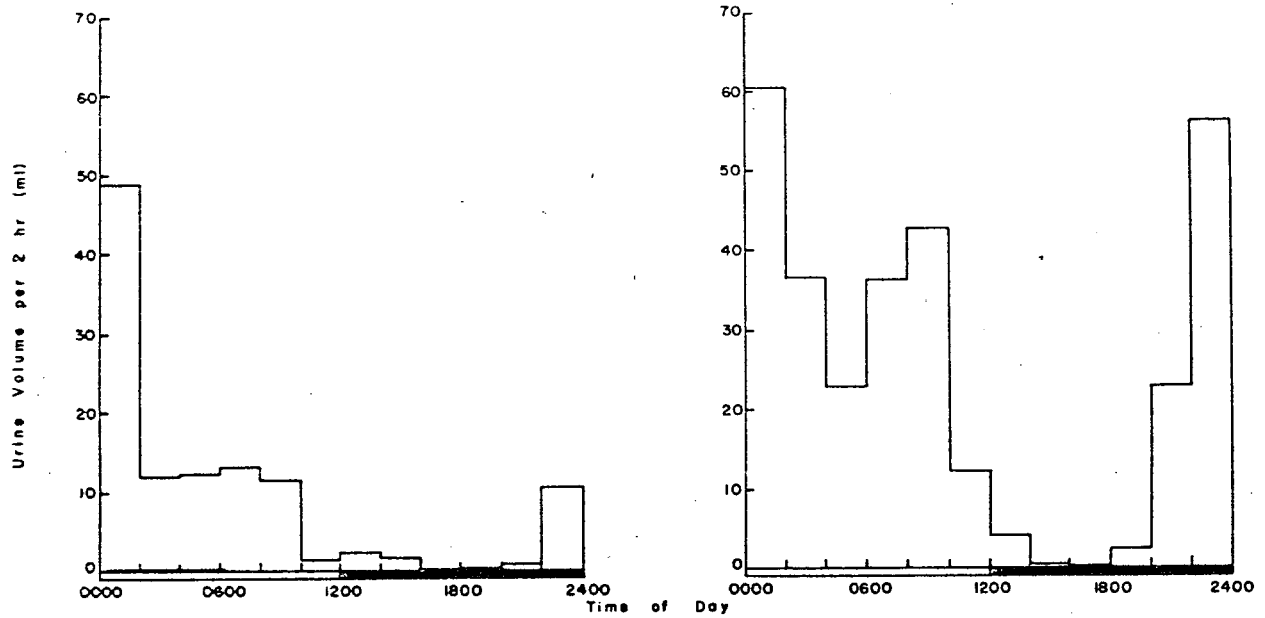on at 0000 hours, off at 1200 hours.

Figure 4.   Average urine volume (two hour samples) during month prior to
phase shift.   Two male pigtail monkeys. · Lights on at 0000 hours,
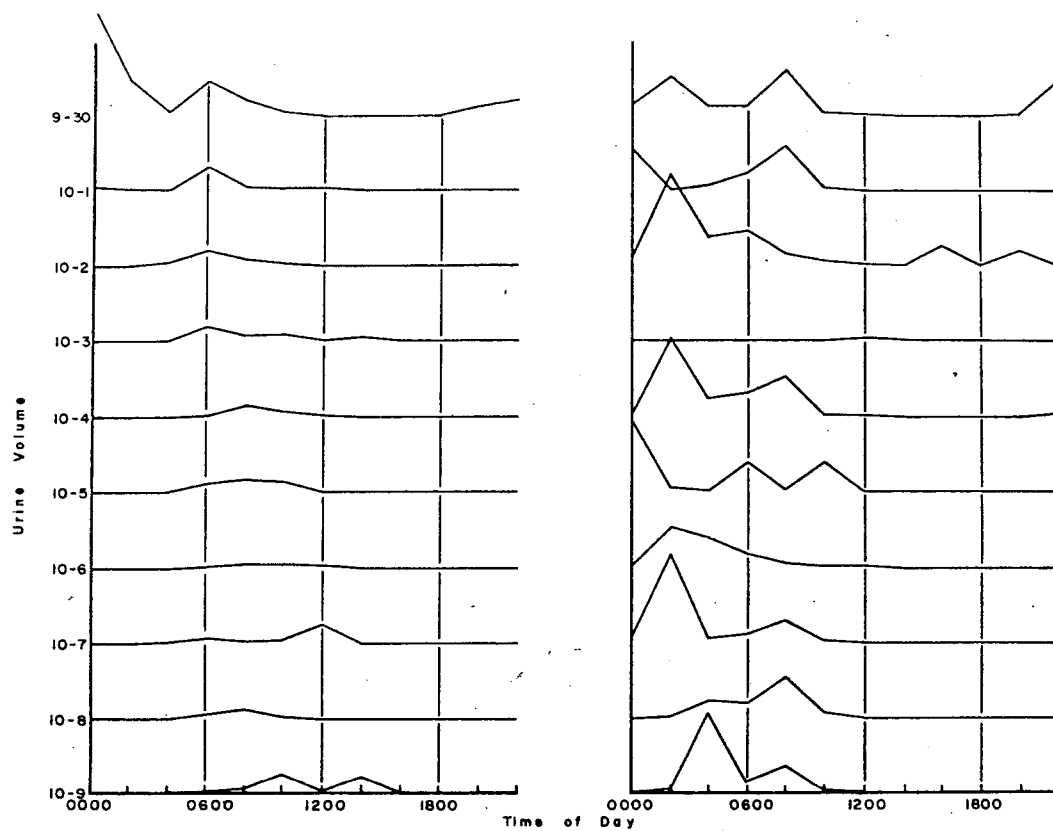off at 1200 hours.

Figure 5.   Urine volumes following six hour photoperiod phase delay on 9-30.
Two male pigtail monkeys. New light schedule: lights on at 0600 hours,
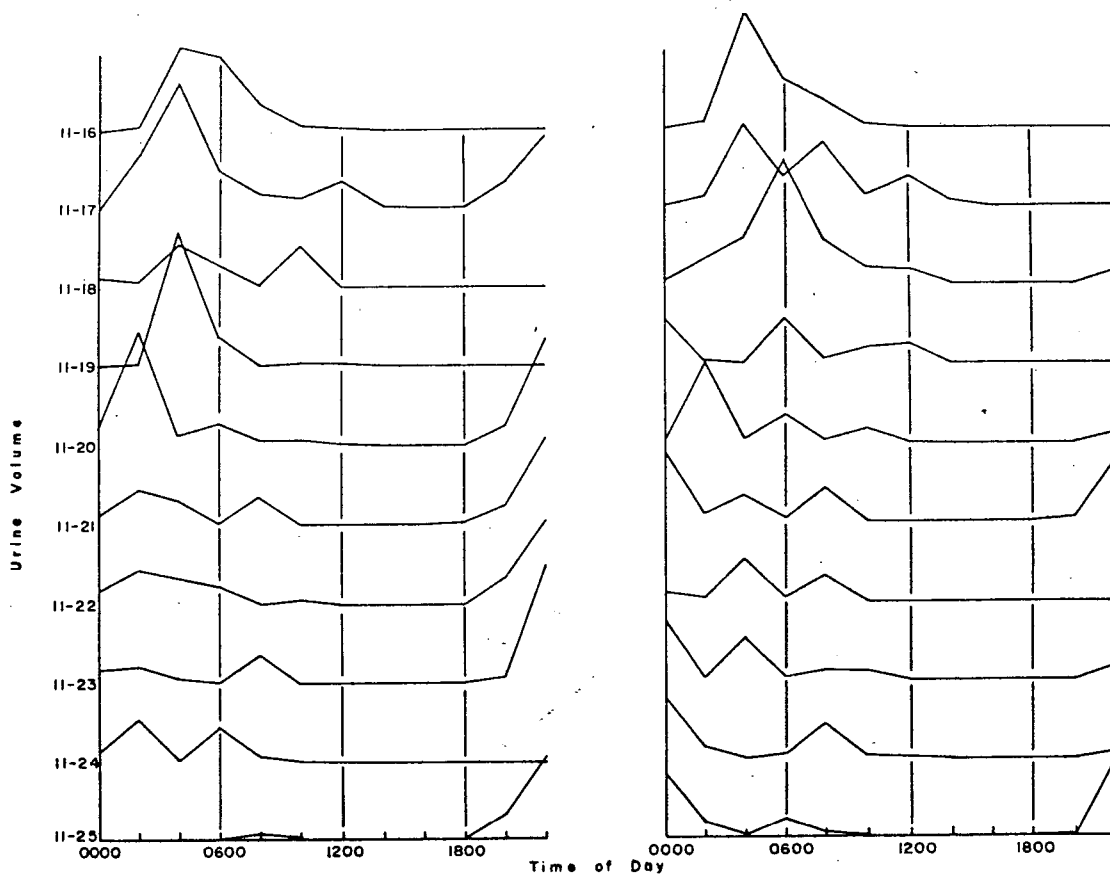off at 1800 hours.

Figure 6.   Urine volumes following six hour photoperiod phase advance on
11-16.   Two male pigtail monkeys.   New light schedule: lights
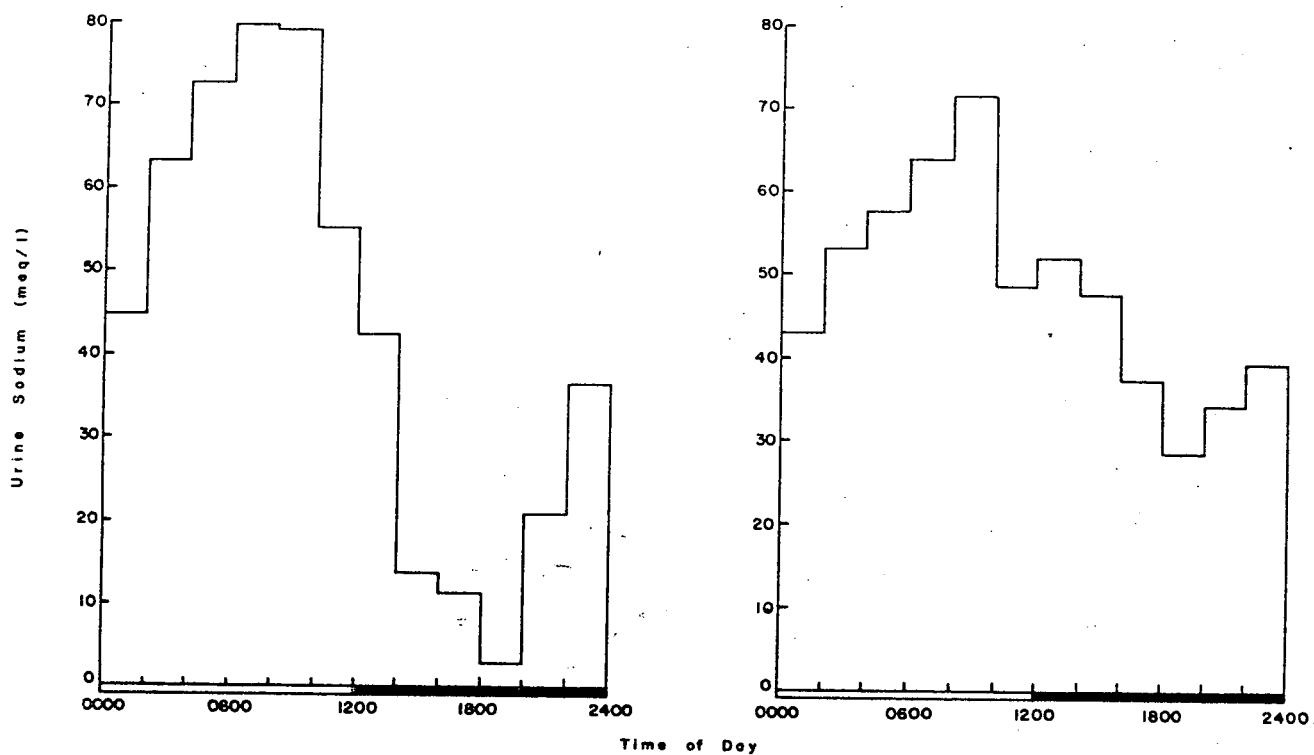on at 0000 hours, off at 1200 hours.

Figure 7.   Average urinary sodium concentration (two hour samples) during
month prior to phase shift.   Two male pigtail monkeys.   Lights
on at 0000 hours, off at 1200 hours.
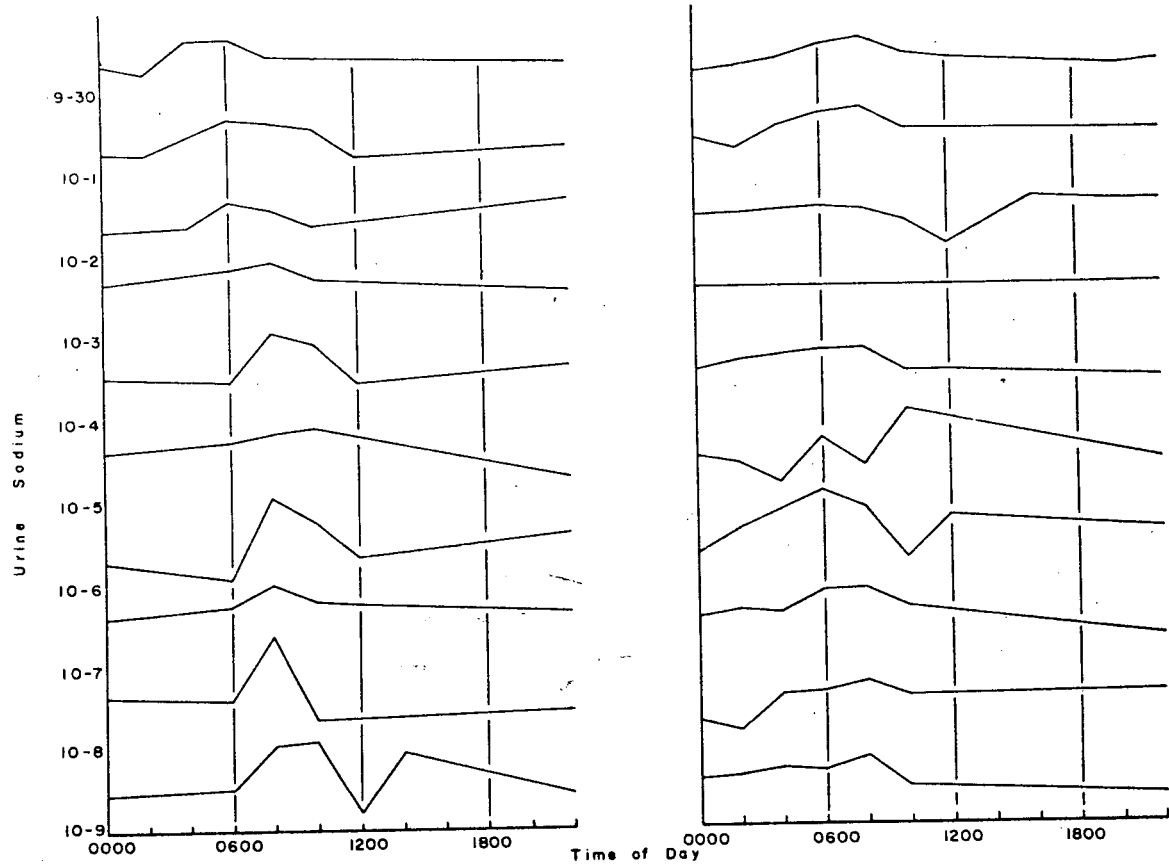
Figure 8.   Urinary sodium concentrations following six hour photoperiod
             phase delay on 9-30.   Two male pigtail monkeys.   New light
             schedule: lights on at 0600 hours, off at 1800 hours.
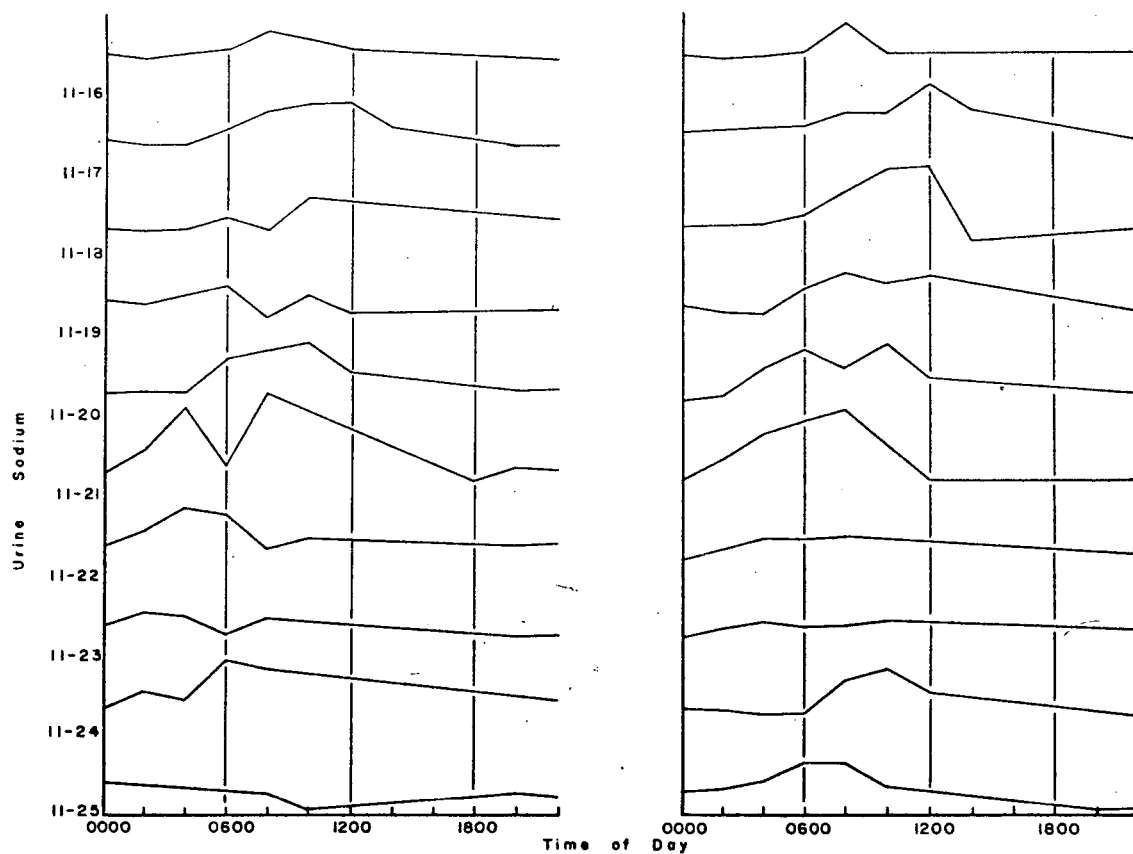
Figure 9.   Urinary sodium concentrations following six hour photoperiod
             phase advance on 11-16. Two male pigtail monkeys. New light
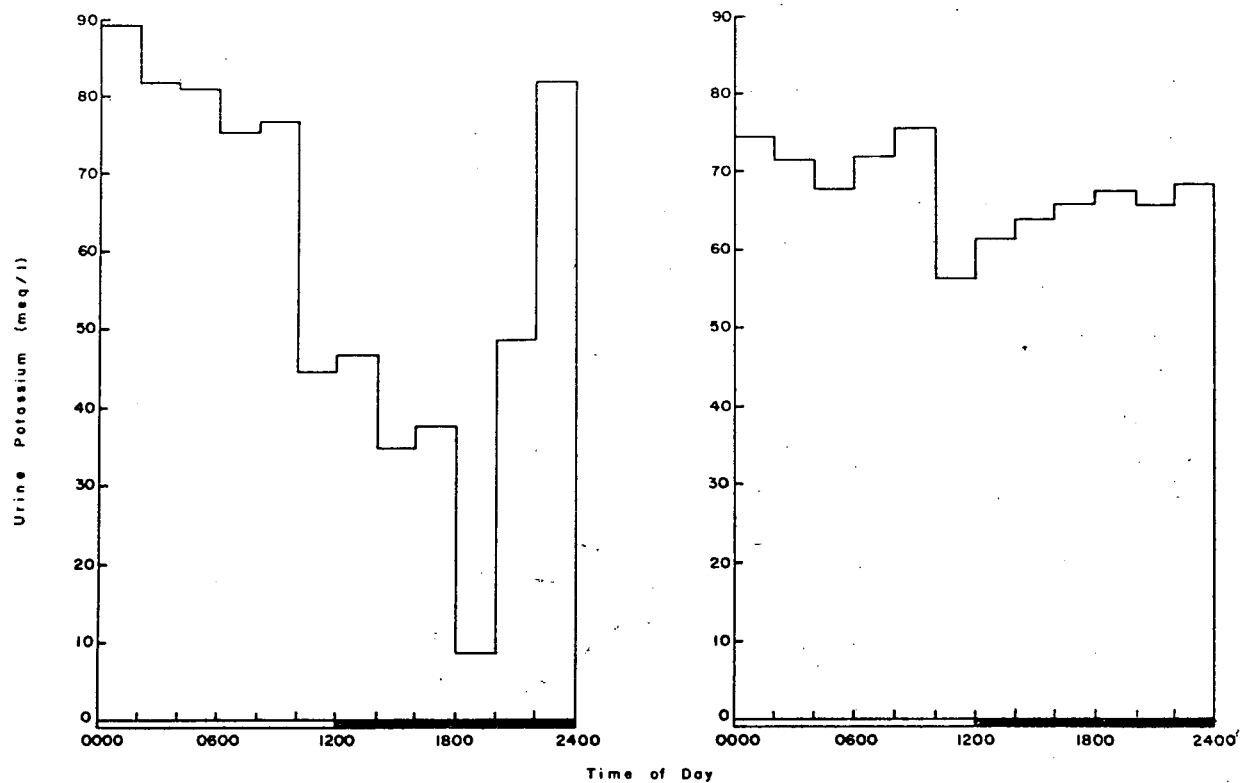   schedule: lights on 0000 hours, off at 1200 hours.

Figure 10.   Average urinary potassium concentration (two hour samples) during
month prior to phase shift. Two male pigtail monkeys. Lights
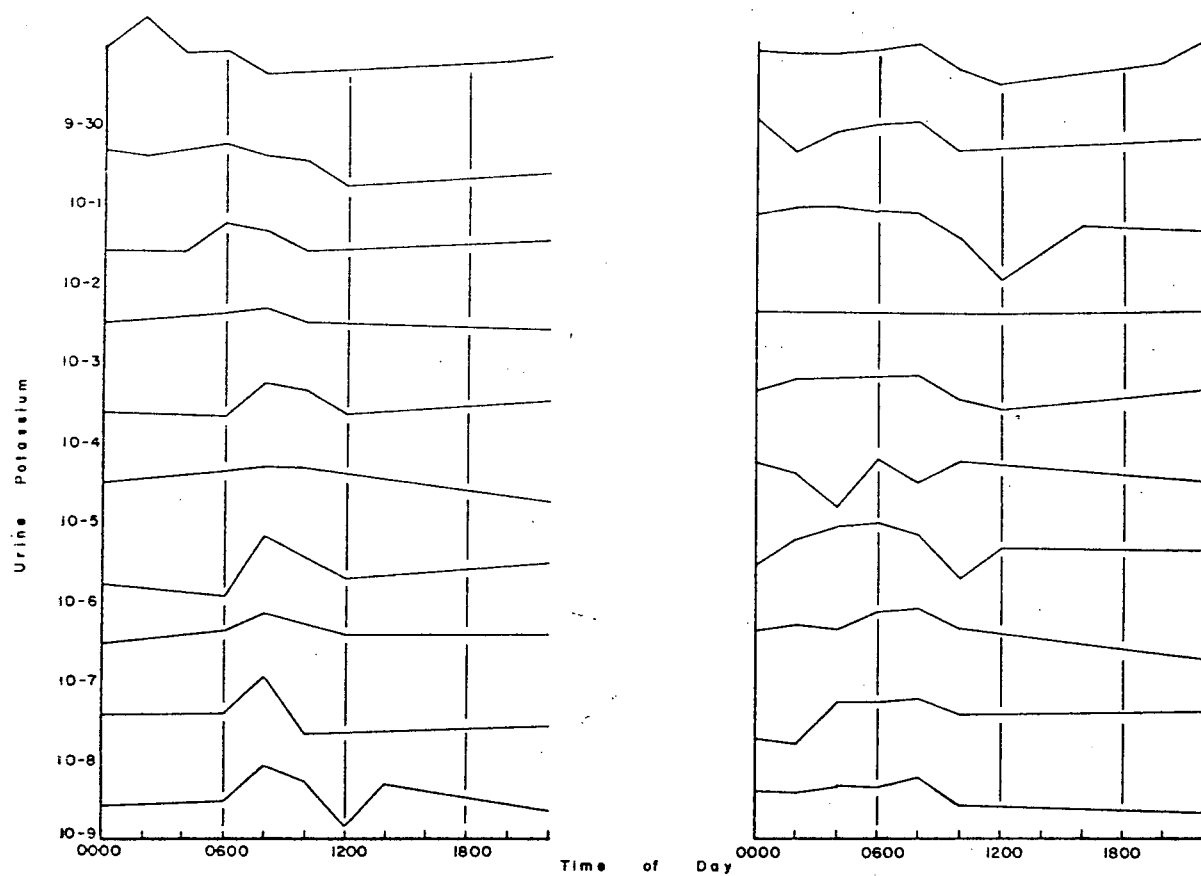on at 0000 hours, off at 1200 hours.

Figure 11. Urinary potassium concentration following six hour photoperiod phase delay on 9-30. Two male pigtail monkeys. New light schedule: lights on at 0600 hours, off at 1800 hours.
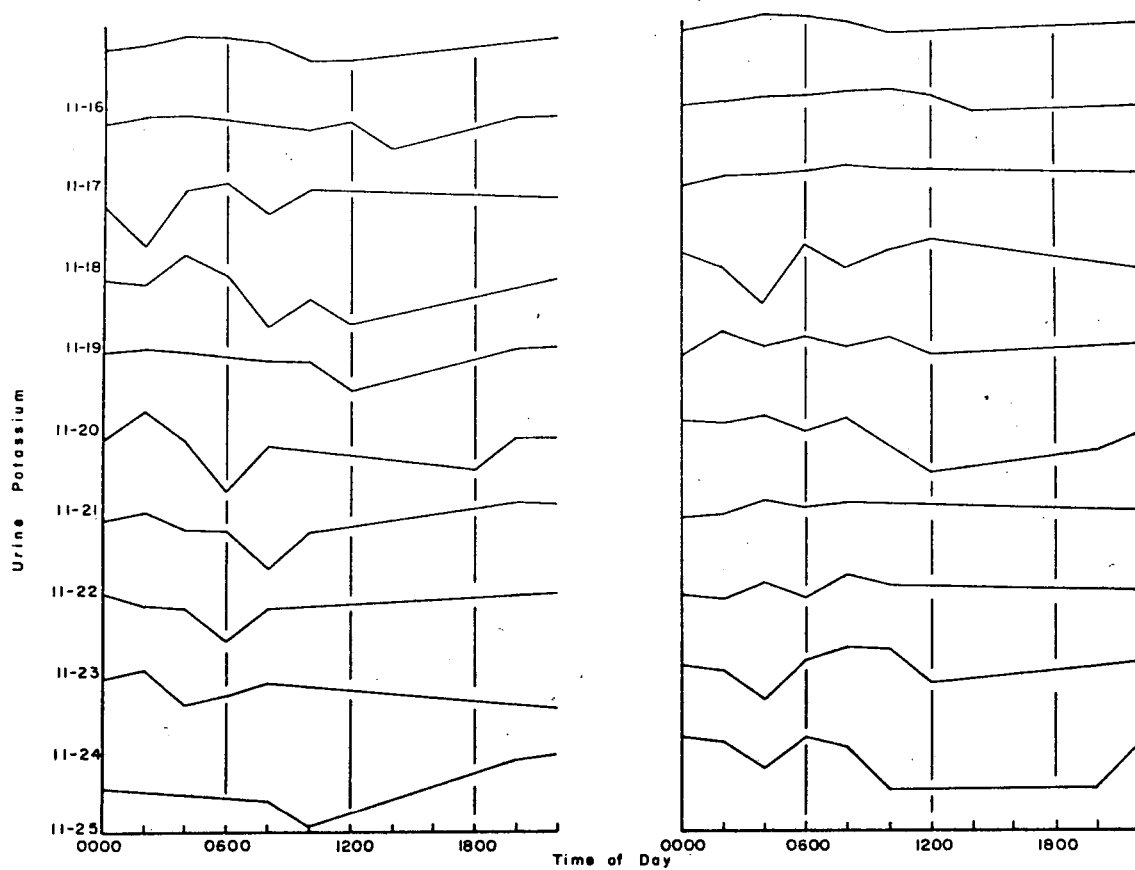
Figure 12.   Urinary potassium concentration following six hour photoperiod
phase advance on 11-16.   Two male pigtail monkeys.   New light
schedule: lights on at 0000 hours, off at 1200 hours.